CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

The contributions of the studies are:

1) This work summarizes available technologies for the management of ULO where these include :
   - Acid clay treatment
   - Chemical and clay treatment
   - Solvent extraction
   - Distillation clay filtration process
   - Ultrafiltration membrane
   - Combustion ULO in boilers, space heater, waste oil furnace
   - Direct burning in cement kiln

   all of which have been successfully commercialized.

2) This work proposed an easy way of selecting technology of ULO.A ULO MANGENENT TECH program was developed as a decision making tool for this propose. Environmental impacts and cost effectiveness were employed as criteria for the selection.

3) The outcomes from this work can be summarized in Table 6.1, which is beneficial for several agencies including :

   3.1) Governmental policy development body and environmentally responsible agencies :

   The results of this study, can be used to propose potential ULO management approaches, and to set up a polluter–paid principal. For instance, the cost effectiveness indicators might show that the re-refining approach is worth investing. Consequently, the governmental

organization might consider having some sort of support e.g. moderate or low tax of treated oil products from these treatment technologies. In this way, not only is the problem of disposal of ULO or the problem of loopholes illegal ULO market reduced, the revenue from low-tax ULO also encourages the treatment of ULO instead of dumping it in sewer systems.

3.2) ULO generators :

The ULO generation sectors can use ULO MANAGEMENT TECH program as a guideline to check the trend or the potential results both in environmental and economical aspects. For example, this will aid in the decision making process between disposing of ULO to other treatment agencies or to invest in the treatment technology themselves. Indeed, specific data can be added to replace old or out-dated data points in the program, which will improve the accuracy of the simulation results

6.2 RECOOMENDATIONS FOR FURTHER STUDIES

1) One of the major problems found in this work is the availability of the data. It would be more appropriate to use primary data for all calculations to increase the accuracy of the results.

2) Other interesting criteria or indicators that should be employed for further studies are tax of production or royalty fee, cost of collecting sample, measurement sample and transportation systems should also be considered. In addition the accepted price of treated oil or other valuable products are the consequential weighed.

3) In this work, cost analysis might be used if comparisons between various technological options are required. However, future research should also focus on how to normalize the waste stream in order to facilitate the comparison regarding environmental performance between these various technologies.

Table 6.1 Conclusion of the proposed ULO management technologies

Item	Acid-clay	Chemical clay	Solvent extraction	Distillation clay Filtration	Membrane	Combustion in boiler	Burning in Cement kiln
1) Input							
ULO (ton)	100	6,800	3,400	8,500	313	510	16,986
H_2SO_4	/						
Clay	/	/	/	/			
Ammonium salt solution		/					
Hydrogen & catalyst		/					
Solvent			/				
Liquid CO_2					/		
2) Output							
Product							
Lube oil (ton)	60	5,440	2,380	3,655	300		
Heavy Lube Oil (ton)				680			
Fuel (ton)				1,190			
Energy (million Kcal)						500	166,174
Waste stream							
Wastewater	8.6	312		1,700			
Acid sludge	18.2						
Spent clay	13.2	95	221	510			
Filter cake		612					
Solvent sludge			146				
Residue			653	1,105	13		
PM						51	
SOx						11.8	
NOx							0.0074
3) Financial (million Bt)							
Cost							
Investment	25.85	224.56	97.76	301.58	5.21	0.38	10
Operating	3.93	72.16	329.13	325.30	2.47	1.25	1
Revenue (per year)	5.28	478.72	209.44	334.18	26.4	0.16	11.25
4) Comparison							
Average cost of 1 ton ULO	72,486	14,559	45,692	9,988	10,114	21,668	146
Average revenue of 1 ton ULO	52,800	70,400	61,600	39,300	84,480	3,189	662
B/C ratio	0.73	4.84	1.35	3.93	8.35	0.15	4.53